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Development of 3D model for part of Hyderabad city

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Abstract— **Urban models are computer-based simulations used for testing theories about spatial location and interaction between land uses and related activities. They also provide digital environments for testing the consequences of physical planning policies on the future form of cities. As computers, software and data have become richer, and as our conception of the way complex systems such as cities grow from the bottom up have been reinforced, urban models have moved from theories and structures that articulate land use and movement in aggregate static terms, to more dynamic models of individual behaviour from which spatial structure emerges.**

I. INTRODUCTION

3D city models of urban areas are an important input for many applications in the field of urban monitoring. Besides the creation and updating of maps from sprawling urban settlements the models are also used for simulation and planning in case of catastrophic events like flooding, tsunamis or earth quakes. With the availability of very high resolution (VHR) satellite data investigations of large urban areas regarding their three dimensional shape can be performed fast and relatively cheap in comparison to aerial photography. Most of the actual methods used for the generation of city models depend on a large amount of interactive work.

In the domain of emergency response to natural disasters (e.g. earthquakes, tsunamis) and man-made conflict events (e.g. large scale destruction), rapid situation assessment is crucial for initiating effective emergency response actions.

Accurate cartographic feature extraction, map updating, digital city models and 3D city models in urban areas are essential for many applications, such as town planning, strategic operations, disaster management, mapping of buildings and their heights for line of sight, simulation of new buildings, Viewshed analysis, updating and keeping cadastral databases current, change detection and virtual reality.

II. OBJECTIVES

- Collection of ground control points using DGPS survey.
- Generation of Digital Elevation Model.
- Automatic Extraction of Foot prints of buildings.
- To develop techniques for 3D modelling of buildings for urban morphological analysis.

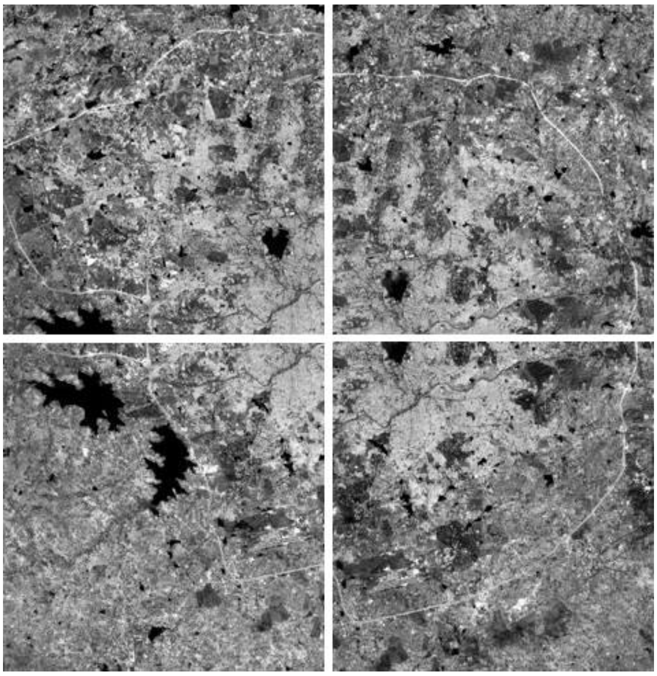
III. STUDY AREA

A part of the Hyderabad city, is taken in to consideration. **Hyderabad** is the capital and largest city of the southern Indian state of Telangana. Occupying 650 square kilometers (250 sq mi) on the banks of the Musi River, it has a population of 6.8 million in 2011 with a metropolitan population of 7.75 million, making it India's fourth most populous city and sixth most populous urban agglomeration.

IV. DATA USED

Cartosat-1 Stereo, Cartosat-2 B mono, LISS-4, LiDAR data, GPS data and other ancillary data.

Cartosat-1 stereo data pair dated were used to generate the DEM. CARTOSAT-1 is an Indian satellite – the 11th one in the IRS (Indian Remote Sensing) series designed to provide quality Earth imagery for telemetry and digital mapping. The satellite carries two panchromatic sensors capturing images forward (26 degrees) and backwards (5 degrees). Images are recorded almost simultaneously in both directions along the satellite's orbit plane or with an inclination, if needed. The sensors cover the swath about 30 km wide with the resolution of 3 m (+26 degrees) and 2,5 m (-5 degrees). As per the agreement made the data procurement has done by SAC Ahmedabad. The figure 1 below shows the cartosat 1 images of the study area.



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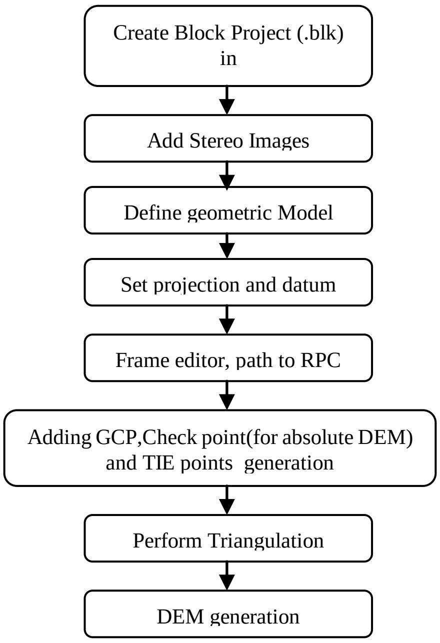
	A	B	C	D	E
1	point id	latitude	longitude	Height	
2	gcp 23	17.18184	78.54825	493.424	
3	gcp01	17.61587	78.3183	498.236	
4	gcp02c	17.50037	78.28467	479.734	
5	gcp3	17.42368	78.26437	499.47	
6	gcp04b	17.59559	78.40165	542.308	
7	gcp05	17.47455	78.38218	496.351	
8	gcp06	17.4013	78.36533	463.994	
9	gcp07	17.55668	78.53974	521.501	
10	gcp08	17.49715	78.49614	484.29	
11	gcp09	17.38856	78.47652	434.162	
12	gcp10	17.57797	78.60489	501.006	
13	gcp11	17.46964	78.59164	461.74	
14	gcp12	17.37961	78.5773	403.224	
15	gcp13	17.55049	78.69259	509.915	
16	gcp14	17.45441	78.66291	406.205	
17	gcp15	17.35296	78.65684	399.125	
18	gcp16	17.31573	78.25899	531.853	
19	gcp17	17.23399	78.2236	511.062	
20	gcp18	17.30471	78.3678	464.971	
21	gcp20	17.18201	78.32925	511.935	
22	gcp20a	17.28188	78.46466	499.878	
23	gcp21	17.1872	78.4387	540.4	
24	gcp22	17.26356	78.54144	483.626	
25	gcp24	17.25133	78.61912	466.134	
26	gcp25	17.1408	78.59439	484.59	

Figure: 2 Results of DGPS Survey

V. FIELD DATA ACQUISITION

The purpose of DGPS is, essentially, to transform the absolute positioning of a point in a relative positioning in comparison with another that can be considered fixed and of known coordinates in a determinate reference system. DGPS points are acquired at various places in the study area. The rover is connected to the permanent reference station placed on IST-JNTUH and Static Survey is conducted. A total number of 25 points are acquired all over the Hyderabad city which are equally distributed on the image. The survey has been done from 30th of August 2011 to 16th of September 2011. Later the data is undergone processing and the result is generated. The result is shown in the figure 2. The points taken were from DGPS(Differential Global Positioning System) Trimble 5700 instrument which is of dual frequency and having an accuracy of approx 0.86cm (as provided by the instrument).

VI. DIGITAL ELEVATION MODEL



Flow chart describing the process for DEM generation

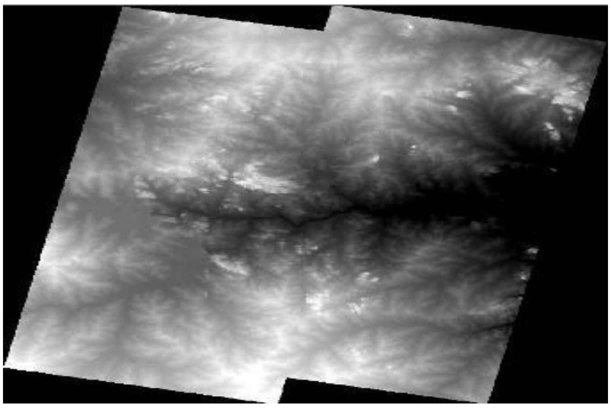


Figure: 4. Digital Elevation Model

VII. OBJECT ORIENTED CLASSIFICATION

Multi-resolution segmentation, as one of the most popular approaches in object oriented image segmentation, has been greatly enabled by the advent of the commercial software, eCognition.The with extracting of foot prints of buildings on the Cartosat-II image of part of Hyderabad city. The footprints are extracted in the form of shape files using Trimble eCognation Software. The shape files generated are applied in building 3D city model for urban development. In this process the Cartosat-II images of study area **Geo-referenced and mosaicked** and the image is undergone Multi resolution segmentation. The shape files generated are overlaid on the digital elevation model generated from the Cartosat-I images of the study area. A model has been defined in the ecognation software by which the unwanted areas other than buildings are separated. Figure 5 shows the algorithm defined for segmentation of the Cartosat 2 image.

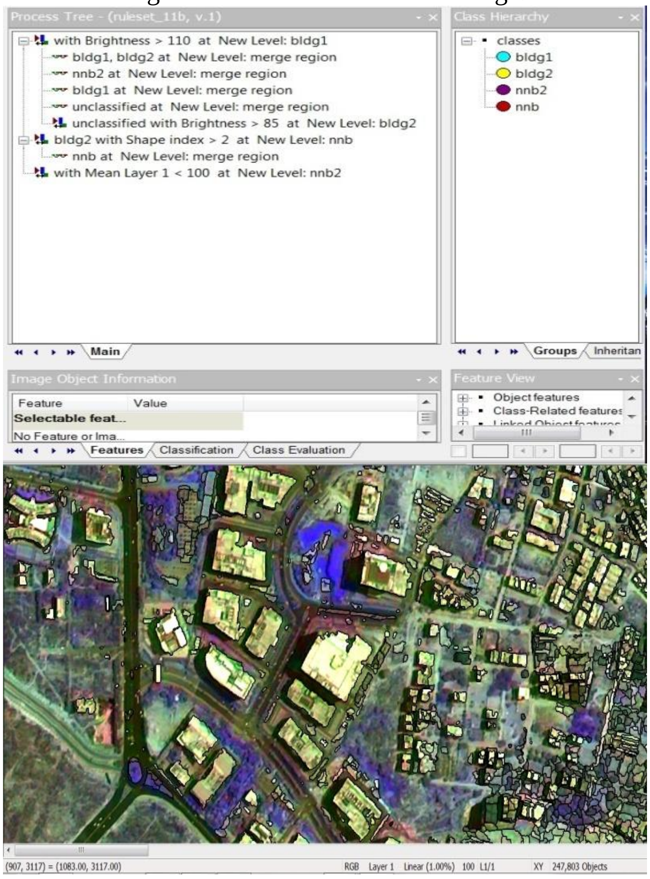


Figure: 5. Algorithm defined for Segmentation Figure: 6. Image showing the Foot prints of Building

VIII. 3D City Model

The foot prints which are generated using ecognation are overlaid on the DEM. The overlaying process is done in LPS. The mean height will be generated in zonal attributes and the mean height of the building shape file will read from the DEM. Later these shape files are transferred in to Arc Scene were we define Extrusion to the mean. After extrusion is defined the buildings are elevated as to their heights as shown in the figure 7.

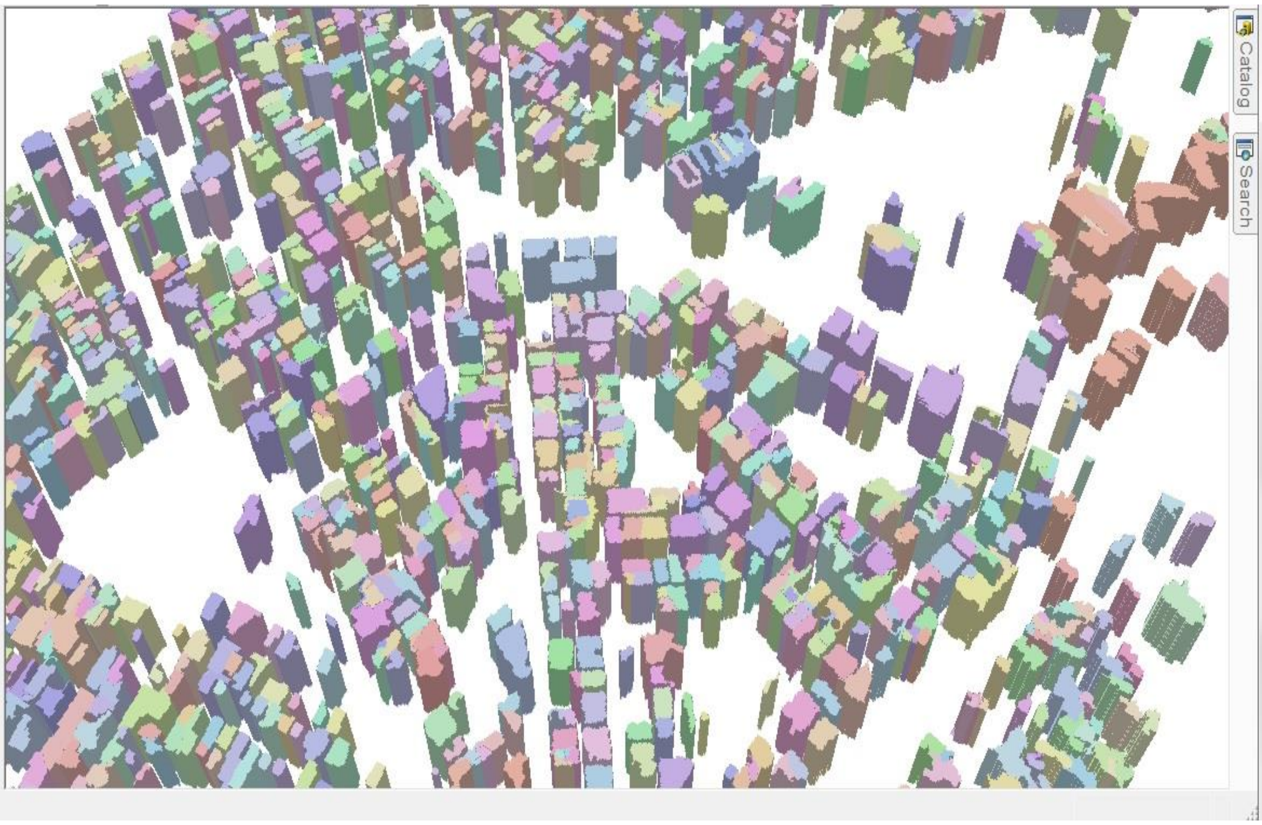


Figure: 7. 3D City Model

IX. Conclusion

3D city models provide an intuitive media for the visualization and comparison of urban design proposals. With contemporary 3D city modelling methods 3D city models can be prepared in a level-of-detail sufficient for urban master planning as well as for detail studies. Software solutions for the authoring, management and visualization of 3D city models provide powerful tools to support the utilization of the chosen approach.

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